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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
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A method of controlling an electronic device

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A method of controlling an electronic device

The invention relates to a method of controlling an electronic device, and in particular to a method comprising the step of switching the electronic device into a mode with reduced power consumption.

The invention further relates to a computer program enabling a programmable device to carry out a method of controlling an electronic device.

The invention also relates to an electronic device, and in particular to an electronic device comprising a control unit able to switch the electronic device into a mode with reduced power consumption.

This method is for example used in TVs having a timer function. A user of such a TV is able to specify an amount of time, after which the TV automatically switches into a standby mode. In a standby mode, a TV generally consumes less power than in a viewing mode. A drawback of the timer function is its inefficiency. It often happens that the user has stopped watching TV more than 5 minutes before the TV switches into a standby mode.

It is a first object of the invention to provide a method of the kind described in the opening paragraph, which enables further reduction in power consumption.

It is a second object of the invention to provide an electronic device of the kind described in the opening paragraph, which is able to reduce power consumption further.

The first object is according to the invention realized in that the method comprises the steps of: detecting a state of a user; determining whether the user is asleep based on the state of the user; and switching the electronic device into a mode with reduced power consumption if the user is determined to be asleep. Advantageously, this method allows the electronic device to reduce power when a user is asleep. The user will generally not mind if for example a radio or TV stops generating output, i.e. sound and/or video, when he/she is asleep. If there are multiple simultaneous users of one electronic device, the method

may detect a state of one of the multiple users, multiple states of the multiple users, or a combined state of the multiple users. The electronic device may for example be switched into a mode with reduced power consumption if all of the multiple users are determined to be asleep.

As an additional advantage, the method according to the invention reduces the chance that the electronic device wakes up the user.

In an embodiment of the method of the invention, the step of detecting a state of a user comprises measuring brain waves of the user. Brain waves may for example be measured by using a suitable detector connected so as to have a neutral point, e.g. the ear lobo, and a measurement point, i.e. any point in contact with the brain. For brainwave measurement, direct contact with the user is not absolutely necessary: remote brain wave measurement is also possible.

The step of detecting a state of a user may comprise detecting a movement of the user. An infrared sensor, which is able to detect changes in background temperature, or an accelerometer, may for example be used to detect movement.

The step of determining whether the user is asleep may comprise determining whether movement of the user has been detected during a predetermined amount of time. If the user has not moved for a longer time, it is very likely that he/she is asleep.

The method may further comprise the step of adapting output generated by the electronic device based on the state of the user. If it is likely, but not certain, that a user is asleep, the output may advantageously be adapted. This feature may not only be used to reduce power consumption, but also to verify whether a user is asleep. Output may for example be adapted after a predetermined amount of time in which no movement has been detected and in such a way that a user will notice if he/she is not asleep. He/she may automatically or purposely move upon noticing the adaptation, thereby triggering a change in the detected state.

The step of adapting output generated by the electronic device may comprise at least one of: reducing volume of sound output by the electronic device, reducing quality of sound output by the electronic device, reducing size of images output by the electronic device, and reducing quality of images output by the electronic device. These measures generally reduce power consumption and are likely to be noticed by the user.

The second object is according to the invention realized in that the electronic device comprises: a receiver for receiving from a detector a detection signal comprising a state of a user; and a control unit able to use the receiver to receive the detection signal from

the detector, able to determine whether the user is asleep based on the state of the user, and able to switch the electronic device into a mode with reduced power consumption if the user is determined to be asleep.

As an additional advantage, the electronic device according to the invention reduces the chance that the electronic device wakes up the user.

In an embodiment of the electronic device of the invention, further comprised is an output means able to generate an output signal and the control unit is able to adapt the output signal based on the state of the user.

The electronic device may further comprise a motion detector. This embodiment is for example advantageous for televisions and wearable electronics. A television may for example comprise an infrared sensor and a wearable electronic device, e.g. a portable MP3 player, may for example comprise an accelerometer.

These and other aspects of the method and electronic device of the invention will be further elucidated and described with reference to the drawings, in which:

Fig.1 is a flow diagram of the method of the invention;

Fig.2 is a flow diagram of an embodiment of the method;

Fig.3 is a block diagram of the electronic device of the invention;

Fig.4 is a schematic representation of a first embodiment of the electronic device; and

Fig.5 is a schematic representation of a second embodiment of the electronic device.

Corresponding elements within the drawings are identified by the same reference numeral.

The method of the invention, see Fig.1, comprises three steps. Step 1 detects a state of a user. Step 3 determines whether the user is asleep based on the state of the user. Step 5 switches the electronic device into a mode with reduced power consumption if the user is determined to be asleep.

Step 1 may comprise measuring brain waves of the user and/or detecting a movement of the user. The basic phases of sleep, by convention, are divided into two main types: REM (Rapid Eye Movement, or dreaming) and Non-REM (NREM). NREM generally

is broken into four phases. In each phase, brain waves become progressively larger and slower, and sleep becomes deeper. After reaching phase 4, the deepest period, the pattern reverses, and sleep becomes progressively lighter until REM sleep, the most active period occurs.

Each of these five phases is characterised by a wave pattern that is easy to identify:

1. **Beta waves** (very low amplitude, high frequency; 13 to 30 waves/sec): A person is awaken and active (in a state of alertness). They are the fastest waves and signal an active cortex and an intense state of attention.
2. **Alpha waves** (low amplitude, 8 to 13 waves/sec): A person is awakened and relaxed, with closed eyes.
3. **Theta waves** (low-medium amplitude, spike-like waves; 3-7 waves/sec): A person is sleepy, already sleeping, or in a sleep transition.
4. **Delta waves** (high amplitude, low frequency; 3 waves/sec): A person is deep asleep.
5. **REM** (60 to 70 waves/sec): Deep active sleep.

By means of measuring brain waves it is possible to identify the state of a person as awake or in a given sleeping phase.

An embodiment of the method is shown in Fig.2. Step 1 detects a state of a user. Step 3 determines whether the user is asleep based on the state of the user. Step 5 switches the electronic device into a mode with reduced power consumption if the user is determined to be asleep. Step 3 may comprise determining whether movement of the user has been detected during a predetermined amount of time (X). If no movement has been detected for a predetermined amount of time or a certain brain wave pattern is identified, e.g. Delta waves or REM, step 3 may determine that the user is asleep. If step 3 determines that the user is asleep, step 5 will be executed next. If movement was detected a few seconds before step 3, the user is most likely not asleep. If Beta waves and possibly Alpha waves are being detected, the user is certainly not asleep. If step 3 determines that the user is most likely not or certainly not asleep, step 1 will be executed next.

After step 5, step 1 may be executed next. Whether step 1 will be executed after step 5 may depend on the identified brain wave pattern or the amount of time that no movement has been detected. If delta waves are being detected or no movement has been

detected during a period X1, the electronic device may for example enter a hibernation mode, in which a resume is still possible. If REM sleep is being detected or no movement has been detected during a period X2 (X2>X1), the electronic device may for example fully switch off. In another embodiment, the electronic device may always fully switch off in step 5 and step 1 may never be executed after step 5.

If no movement has been detected for a predetermined amount of time (Y, Y<X), step 3 may determine that the user is probably asleep and step 11 will be executed next. In another embodiment, this determination could be made in a separate step. Step 11 adapts output generated by the electronic device based on the state of the user. Step 11 may comprise reducing volume of sound output by the electronic device, reducing quality of sound output by the electronic device, reducing size of images output by the electronic device, and/or reducing quality of images output by the electronic device. Step 11 may also be executed if Alpha waves or Theta waves are being detected in step 3. The way in which the output is adapted may depend on the identified brain wave pattern. After step 11, step 1 will be executed next.

The electronic device 21 of the invention, see Fig. 3, comprises a receiver 23 and a control unit 27. The receiver 23 is able to receive from a detector 25 a detection signal comprising a state of a user. The detector 25 may be located in the electronic device 21, attached to the electronic device 21, or located outside the electronic device 21. If the detector 25 is a movement detector located outside the electronic device 21, it may for example be located somewhere in a living room or a bedroom. The detector 25 may also be a pressure sensor, for example incorporated into a shoe, a bed, or a pillow, able to detect movement by sensing a change in pressure. The electronic device 21 may for example be a TV, a set-top box, a digital video player, a receiver, an amplifier, a portable CD player, a portable MP3 player, or a portable video player.

The detector 25 may be connected to an input interface 29 of the electronic device 21 via a wire. The input interface 29 may be connected to the receiver 23. The control unit 27 is able to use the receiver 23 to receive the detection signal from the detector 25, able to determine whether the user is asleep based on the state of the user, and able to switch the electronic device 21 into a mode with reduced power consumption if the user is determined to be asleep. The electronic device 21 may further comprise an output means 31 able to generate an output signal. The control unit 27 may control the output means 31. The control unit 27 may be able to adapt the output signal based on the state of the user. The output means 31 may be connected to an output interface 33. The output interface 33 may be

connected to a reproduction means 35. The reproduction means 35 may for example be a TV, a display, an amplifier, a speaker, or an earphone. The output means 31 may for example be a signal converter. The reproduction means 35 and the output means 31 may be implemented in the same hardware component. The control unit 27 and the output means 31 may be implemented in the same hardware component.

A first embodiment of the electronic device 21 is shown in Fig.4. The electronic device 21 comprises a receiver 23 and a control unit 27, as shown in Fig.3. In this embodiment, the electronic device 21 is a television. The television comprises the detector 25 and a reproduction means 35. In this embodiment, the detector 25 is a motion detector, e.g. an infrared sensor or a digital video camera, and the reproduction means 35 is a display. The reproduction means 35 is coupled to an output means 31, as shown in Fig. 3.

A second embodiment of the electronic device 21 is shown in Fig.5. The electronic device 21 comprises a receiver 23 and a control unit 27, as shown in Fig.3. In this embodiment, the electronic device 21 is a portable CD player coupled to a reproduction means 35. The portable CD player comprises a CD reader 43. In this embodiment, the reproduction means 35 is a headphone, i.e. a pair of earphones. The reproduction means 35 is coupled to an output means 31, as shown in Fig. 3. The reproduction means 35 and the electronic device 21 are connected via a wire 41. The reproduction means 35 comprises a detector 25. The detector 25 may for example be an accelerometer or a brain wave measurement module and may be located anywhere in or on the headphone.

While the invention has been described in connection with preferred embodiments, it will be understood that modifications thereof within the principles outlined above will be evident to those skilled in the art, and thus the invention is not limited to the preferred embodiments but is intended to encompass such modifications. The invention resides in each and every novel characteristic feature and each and every combination of characteristic features. Reference numerals in the claims do not limit their protective scope. Use of the verb "to comprise" and its conjugations does not exclude the presence of elements other than those stated in the claims. Use of the article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

'Means', as will be apparent to a person skilled in the art, are meant to include any hardware (such as separate or integrated circuits or electronic elements) or software (such as programs or parts of programs) which perform in operation or are designed to perform a specified function, be it solely or in conjunction with other functions, be it in isolation or in co-operation with other elements. The invention can be implemented by means

of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means can be embodied by one and the same item of hardware. 'Computer program' is to be understood to mean any software product stored on a computer-readable medium, such as a floppy disk, downloadable via a network, such as the Internet, or marketable in any other manner.

CLAIMS:

1. A method of controlling an electronic device, comprising the steps of:
- detecting (1) a state of a user;
- determining (3) whether the user is asleep based on the state of the user; and
- switching (5) the electronic device into a mode with reduced power consumption if the user is determined to be asleep.

2. A method as claimed in claim 1, characterized in that the step of detecting (1) a state of a user comprises measuring brain waves of the user.

3. A method as claimed in claim 1, characterized in that the step of detecting (1) a state of a user comprises detecting a movement of the user.

4. A method as claimed in claim 3, characterized in that the step of determining (3) whether the user is asleep comprises determining whether movement of the user has been detected during a predetermined amount of time.

5. A method as claimed in claim 1, characterized by further comprising the step of adapting (11) output generated by the electronic device based on the state of the user.

6. A method as claimed in claim 5, characterized in that the step of adapting (11) output generated by the electronic device comprises at least one of: reducing volume of sound output by the electronic device, reducing quality of sound output by the electronic device, reducing size of images output by the electronic device, and reducing quality of images output by the electronic device.

7. A computer program enabling a programmable device to carry out a method as claimed in claim 1.

8. An electronic device (21), comprising:

- a receiver (23) for receiving from a detector (25) a detection signal comprising a state of a user; and
- a control unit (27) able to use the receiver (23) to receive the detection signal from the detector (25), able to determine whether the user is asleep based on the state of the user, and able to switch the electronic device (21) into a mode with reduced power consumption if the user is determined to be asleep.

9. An electronic device (21) as claimed in claim 8, characterized in that:
- further comprised is an output means (31) able to generate an output signal; and
- the control unit (27) is able to adapt the output signal based on the state of the user .

10. An electronic device (21) as claimed in claim 8, characterized by further comprising a motion detector.

ABSTRACT:

The method of the invention detects (1) a state of a user, determines (3) whether the user is asleep based on the state of the user, and switches (5) the electronic device into a mode with reduced power consumption if the user is determined to be asleep. The computer program of the invention enables a programmable device to carry out the method. The electronic device of the invention contains at least a control unit and a receiver for receiving from a detector a detection signal comprising a state of a user. The control unit is able to determine whether the user is asleep based on the state of the user and able to switch the electronic device into a mode with reduced power consumption if the user is determined to be asleep.

Fig. 2

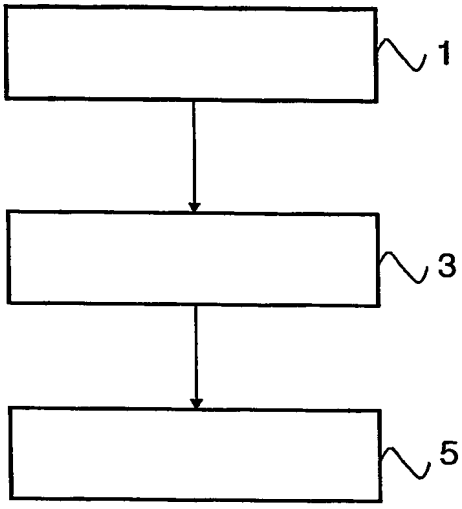

FIG.1

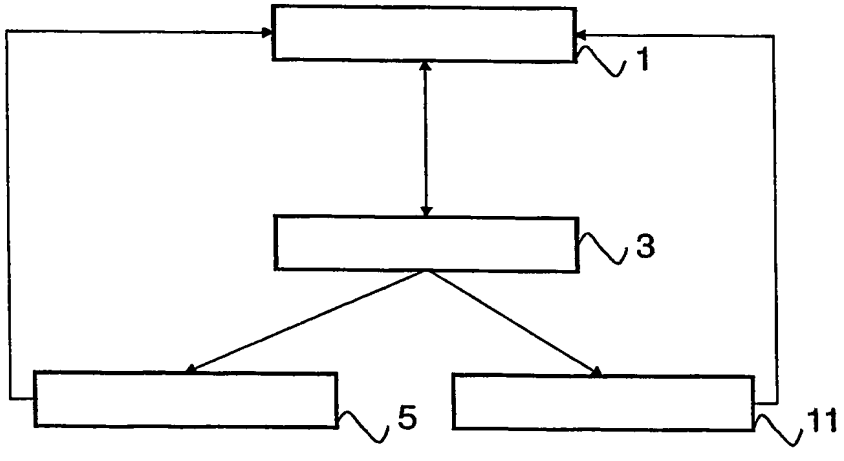

FIG.2

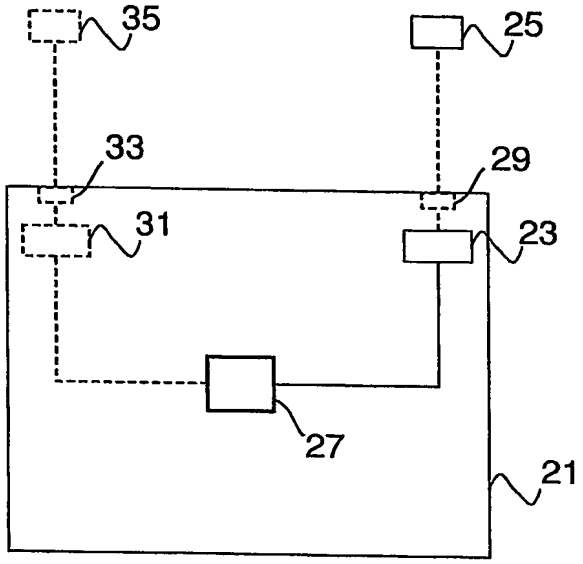

FIG.3

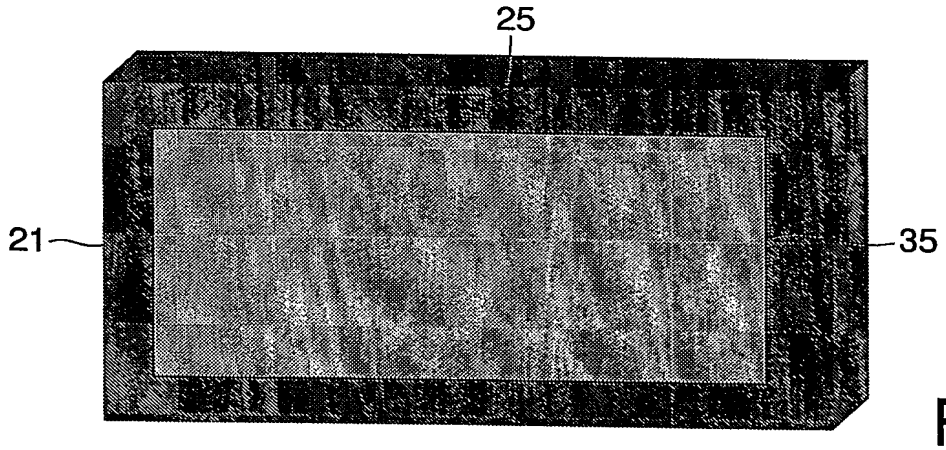

FIG.4

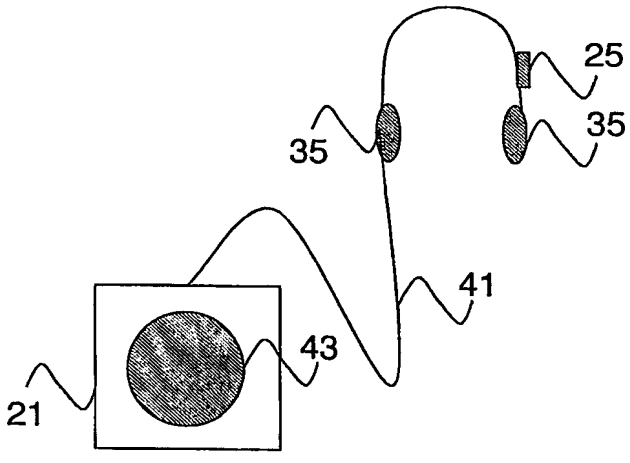

FIG.5

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